CM

WHAT IS CLAIMED IS:

1- In a method for producing a set of magnetic resonance three-dimensional image data, a preparation-acquisition-recovery pulse sequence cycle comprising the steps of:

P1 13 a- a magnetization preparation period in which a series of at least one of RF pulses, gradient field pulses, and time delays are applied to encode the desired contrast properties in the form of longitudinal magnetization,

P1 13 b- a data acquisition period, said data acquisition period including at least two repetitions of a gradient echo sequence to acquire data for a fraction of k-space,

P1 13 c- a magnetization recovery period which allows T1 and T2 relaxation before the start of the next sequence cycle, and

P1 13 d- repeating steps a, b and c until a predetermined k-space volume is sampled.

2- The method of claim 1, wherein at least some of said RF pulses are spatially or chemically non-selective.

3- The method of claim 1, wherein at least some of the preparation-acquisition-recovery sequences cycles are initiated by a trigger signal, whereby said sequence is synchronized with an external temporal event.

4- The method of claim 1, wherein said magnetization recovery period has a time of zero.

42

5- The method of claim 1, wherein at least some of said RF pulses and/or gradient pulses applied during at least one of steps (a), (b), and (c) stabilize responses of the apparatus.

6- The method of claim 1, wherein at least some of said RF pulses and/or gradient pulses applied during at least one of steps (a), (b), and (c) stabilize the magnetization system.

7- The method of claim 5, wherein eddy currents are stabilized.

8- The method of claim 6, wherein there is a stabilization of oscillations in signal strength.

9- The method of claim 1, wherein more than one contrast property is encoded by the magnetization preparation step.

10- The method of claim 1, wherein the duration of at least one step, of steps a, b, and/or c is constant.

11- The method of claim 1, wherein the duration of at least one of steps a, b, and c, varies from sequence cycle to cycle.

12- The method of claim 1, wherein at least some of said RF pulses are at least spatially or chemically selective.

13- The method of claim 12 wherein at least some of said RF pulses are spatially and chemically selective.

14- The method of claim 12 wherein at least some of said RF pulses of at least one of steps a, b, and c, are spatially selective in at least two dimensions.

15- The method of claim 1, wherein said gradient-echo sequence employs at least one of gradient or RF spoiling whereby the effects of residual transverse coherences are reduced or eliminated.

16- The method of claim 1, wherein said gradient-echo sequence employs at least a partially rephased gradient structure.

17- The method of claim 16 wherein said gradient-echo sequence employs a fully rephased gradient structure.

18- The method of claim 1, wherein said gradient-echo sequence employs flip angles which are constant.

19- The method of claim 1, wherein said gradient-echo sequence employs flip angles which vary within a given data acquisition period

20- The method of claim 1, wherein said gradient-echo sequence employs flip angles which vary between data acquisition periods.

21- The method of claim 1, wherein said gradient-echo sequence employs flip angles which vary both within and between data acquisition periods.

22- The method of claim 1, wherein said gradient-echo sequence employs a repetition time which is constant.

23- The method of claim 1, wherein said gradient-echo sequence employs a repetition time which varies within a given data acquisition period.

44

24- The method of claim 1, wherein said gradient-echo sequence employs a repetition time which varies between data acquisition periods.

25- The method of claim 25, wherein said gradient-echo sequence employs a repetition time which varies both within and between data acquisition periods.

26- The method of claim 1, wherein said gradient-echo sequence employs an echo time which is selected from the group consisting of constant, varying within a given data acquisition period, varying between data acquisition period, and varying both within and between data acquisition periods.

27- The method of claim 1, wherein said gradient-echo sequence employs a data sampling period which is constant, or which varies within a given data acquisition period, or which varies between data acquisition periods, or which varies both within and between data acquisition periods.

28- The method of claim 1, wherein said gradient-echo sequence employs one of symmetric sampling of the echo and asymmetric sampling of the echo thereby potentially acquiring only a half echo.

29- The method of claim 1, wherein said gradient-echo sequence acquires the signal in the presence of a single constant applied gradient, and the remaining spatial dimensions are phase-encoded.

30- The method of claim 1, wherein said gradient echo sequence acquires a plane, or a fraction of a plane, of k-space data each sequence cycle.

45

31- The method of claim 1, wherein said k-space data collected by said gradient-echo sequence during a given sequence cycle is not contained in any plane.

32- The method of claim 1, wherein the temporal order in which the k-space data is collected for each sequence cycle is determined based on achieving selected properties in the image.

33- The method of claim 1, wherein the temporal order in which the k-space data is collected for each sequence cycle is determined based on achieving selected contrast properties in said image.

34- The method of claim 1, wherein the temporal order in which the k-space data is collected for each sequence cycle is determined based on achieving selected properties of the corresponding point spread function.

35- The method of claim 1, wherein the temporal order of k-space data collection is fixed.

36- The method of claim 1, wherein the temporal order of k-space data collection varies from sequence cycle to cycle.

37- The method of claim 1, wherein said gradient-echo sequence acquires a fixed amount of k-space data during each sequence cycle.

38- The method of claim 1, wherein said gradient-echo sequence acquires a varying amount of k-space data during each sequence cycle.

39- The method of claim 1, wherein said gradient-echo sequence acquires said data in the presence of at least two constant applied gradients, and any remaining spatial dimensions, employ phase encoding.

40- The method of claim 1, wherein said gradient-echo sequence acquires said data in the presence of from one to three time-varying applied gradients, and any remaining spatial dimensions employ phase encoding.

41- The method of claim 1, therein said gradient-echo sequence employs predetermined gradient waveforms to compensate in the sampled signal for phase shifts due to at least one of flow or motion.

42- The method of claim 41, wherein said compensations are specifically designed for at least one of velocity, acceleration and higher orders of motion.

43- The method of claim 1, wherein in step (b) there is employed data acquisition in the absence of any applied magnetic field gradients and from two to three spatial dimensions are encoded using phase-encoding, whereby, one dimension of the three or four dimensional data set contains chemical shift information.

44- The method of claim 1, wherein said time period employed for magnetization recovery is also employed for magnetization preparation.

-END-

47